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THE MIAMI CONSERVANCY BULLETIN

AUGUST 1919

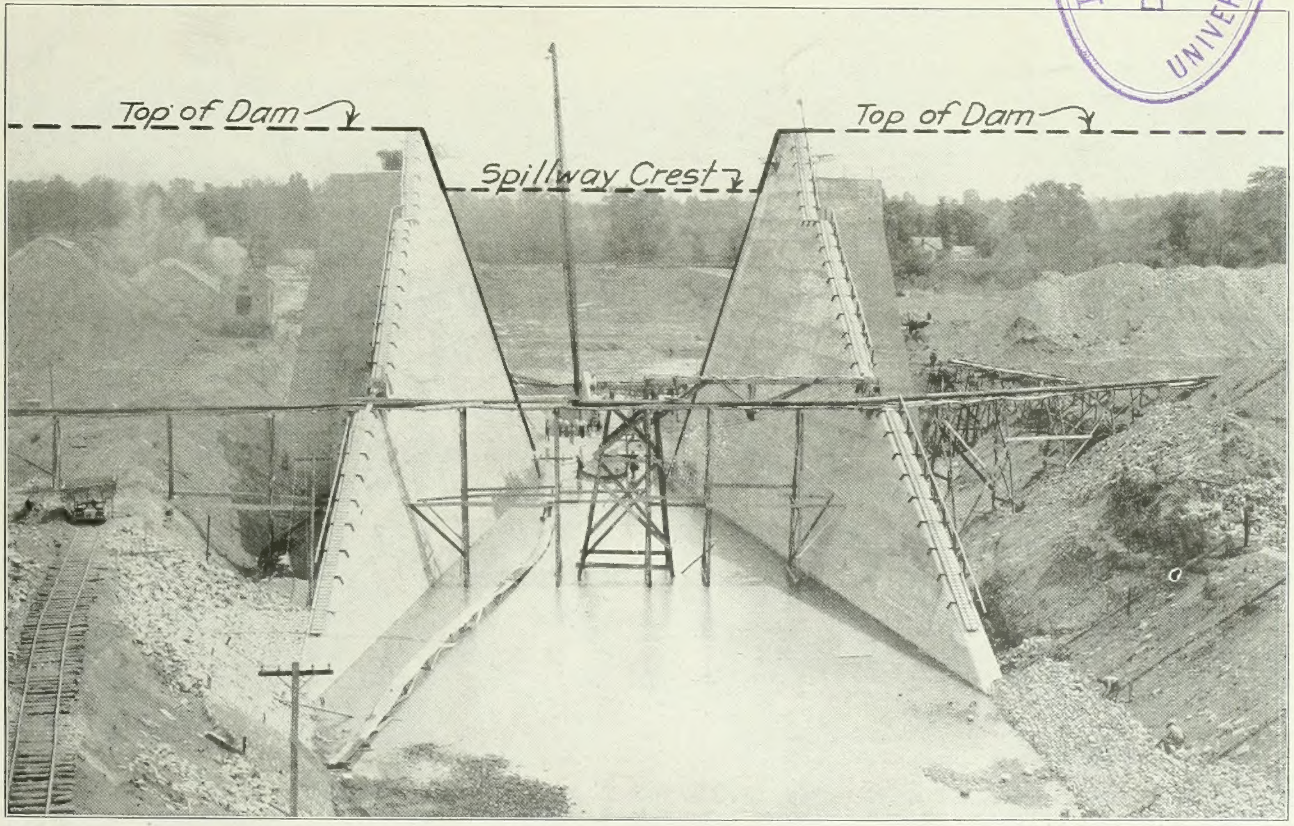

FIG. 1—CONCRETE OUTLET, LOCKINGTON DAM, FROM UPSTREAM END, JUNE 6, 1919

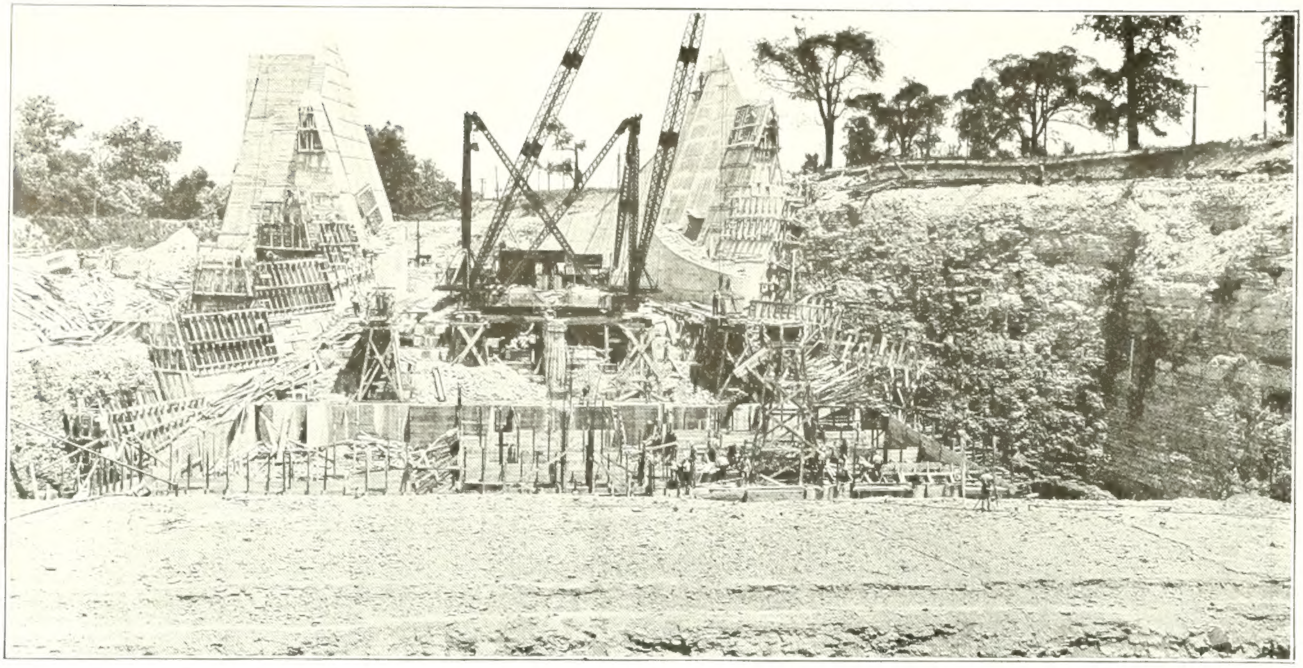

FIG. 2—CONCRETE OUTLET, HUFFMAN DAM, LOOKING UPSTREAM, JULY 10, 1919.
The type of structure is similar to that at Lockington, described elsewhere in this issue. The walls have reached the full height of the dam. The down stream ends are still under construction. The foreground is solid bed rock, ready for the floor of the second pool, the stilling pool. Just beyond this the excavation drops away to the floor of the hydraulic jump pool, (out of sight). Beyond this is seen the concrete stairway descending between the walls. The water will flow down this stairway into the hydraulic jump pool, from which it will pass over a wall to the stilling pool in the foreground. The left-hand portion of the left-hand wall is one of the cut-off walls, at right angles to the main wall.

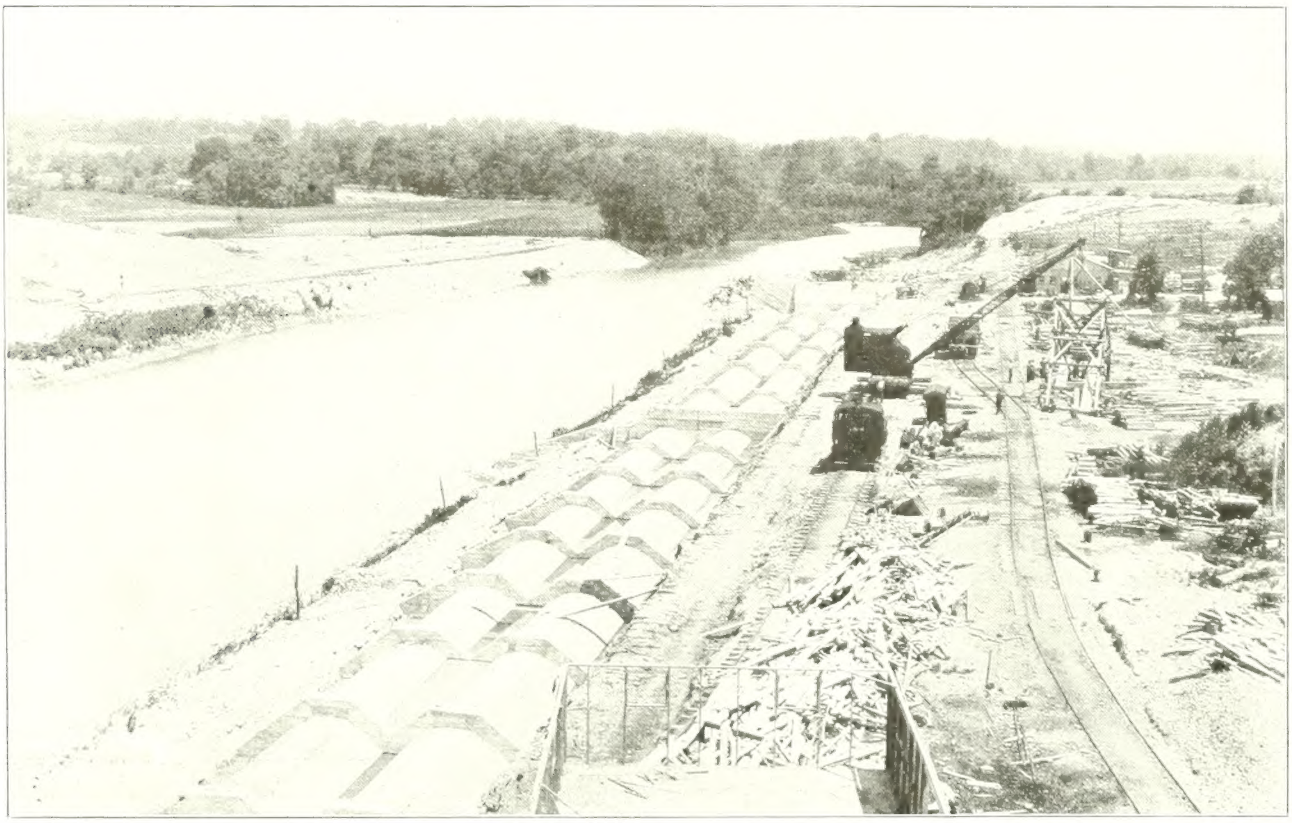

FIG. 3—CONCRETE OUTLET CONDUITS, ENGLEWOOD DAM, LOOKING DOWNSTREAM, JUNE 28, 1919
This is the type of conduit structure, referred to on page 5, which is entirely separate from the spillway structure. Figure 2, above, shows the type wherein conduits and spillway are combined, as also does figure 1 and figure 14. Note the great length of the conduits here (over seven hundred feet), as contrasted with those at Lockington, (the entrances to which are dotted in at the bottom of the wall, the Lockington conduits being not yet built). These conduits will be buried at the center line (at the low wall beside the locomotive) in over 90 feet of earth. The Lockington conduits, on the contrary, will be topped with concrete to the upper dotted line in figure 14.

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THE MIAMI CONSERVANCY BULLETIN

PUBLISHED BY THE MIAMI CONSERVANCY DISTRICT

DAYTON, OHIO

Volume 2 August 1919 Number 1

Index

Subscription to the Bulletin is 50 cents per year. At news stands 5 cents per copy. Business letters should be sent to Office Engineer, Miami Conservancy District, Dayton, Ohio. Matter for publication should be sent to G. L. Teeple, Miami Conservancy District, Dayton, Ohio.

Another Legal Victory

In the Common Pleas Court of Montgomery County, the jury, on July 29, returned two verdicts in favor of the Miami Conservancy District, the cases tried being those of the District versus Rosa Koellsch, and versus Morris Kasmirsky, both property holders in the deeply flooded portion of the city of Dayton. These cases came up on appeals filed by these parties from the award of benefits as determined by the Board of Appraisers on the charge that the amounts were excessive. The findings of the jury were in each instance a complete support of the Board, the exact amount of benefits called for in the appraisal roll being confirmed in each case.

Previous to these two cases, five others, involving in all eleven pieces of property, had been tried, four in the Butler County and one in the Montgomery County court, the verdicts in all of them upholding the benefits determined by the Board of Appraisers. As a result of these decisions the majority of the property holders in Butler County who had perfected their appeals, recently withdrew their cases, thereby accepting the appraisers' awards.

The cases are of interest at this time, aside from their legal aspects, because they tend to confirm the general public opinion that prevailed at the time the Appraisal Roll was approved by the Conservancy Court in June, 1917. At that time property holders were given the right to appeal from the awards of benefits on their properties. Less than one-half of one per cent chose to do so. The other 99½ per cent, in spite of urgings on the part of a few discontented ones, did not appeal. This fact alone is significant, for there are in the District about 70,000 pieces of property which will be benefited by being permanently protected against floods.

The amount of benefits as determined by the Appraisers represents that portion of the property value which is due to flood protection, and by which amount the property value would have depreciated had no flood protection been provided. The flood assessment to be paid by the owner, as now levied, is only 36 per cent of the amount of benefits. The equitable determination of these amounts of benefits was, of course, a big task, and consumed nearly two years. For each parcel of property it was necessary to determine the market value both with and without protection, and the depth of flooding on and surrounding it. The methods used by the Appraisers were worked out with the greatest care, and having once been settled upon were applied with the utmost uniformity and faithfulness.

It is, therefore, gratifying to find the figures of the Appraisers upheld by the courts. As a matter of fact in all of the cases so far tried it was very apparent that the parties who appealed did not have a correct understanding of the true intent and meaning of the appraisal figures. Many mistook the amount of benefits for the assessment. Others quibbled about matters of trifling consequence.

Thus in the case of Rosa Koellsch there was only a trifling difference between the appraisal value and that testified to by the owner. Had the jury found in her favor she would at the most have reduced her assessment by $42.12, which taken over the 30 years in which payments are made, would represent a saving of about a dollar and a half per year.

Eminent Hydraulic Engineer Approves Conservancy Work

Among the engineers who were invited recently to inspect the progress of the work of the District was Daniel W. Mead, consulting hydraulic engineer, of Madison, Wisconsin, the occasion being the completion at three of the dams of the concrete outlet structures. The following statement, made by him following his visit, will be a satisfaction and an additional assurance to all the friends of the Conservancy District.

"My recent examination of the works of the Miami Conservancy District has given me renewed assurance that these works when completed will accomplish all that has been anticipated toward the flood protection of the Miami Valley. The progress made, in view of the war conditions which have obtained since the work began, seems entirely satisfactory. The foundation conditions developed at the dam sites are safer than was expected and have removed the most doubtful element in the flood protection problem. The work is being done so satisfactorily that I see no reasonable way in which it can be improved. The citizens of the Conservancy District are to be congratulated on the efficient and effective organization of the district, the progress and character of the work, the apparent systematic and economical way in which the work is being handled, and the safety to life and property which will follow the completion of the project."

The River Improvement at Hamilton

Attention is called to the article on page 11 in this issue, discussing briefly the problem of river improvement at Hamilton. Public attention, since the flood, has been focused much upon Dayton, due to that city's greater size and to its strategic position in the valley, both tending to make it the natural center of flood prevention activity. But in fact the relative effects of the flood were considerably more serious at Hamilton. The loss of life was several times greater. The problem of improving the river was also considerably more difficult. This was due principally to the constricted channel through the built-up section, some evidence of which may be seen in the fact that the flood swept away every bridge in the city. Following the flood, Hamilton attempted at first, as did the other cities of the valley, to cope with the problem single-handed, and called in the well-known engineer, John W. Hill of Cincinnati. With the perception that the Hamilton problem could be properly solved only as part of a larger project, embracing the valley as a whole, the people of Hamilton merged their interests with those of Dayton. The resulting plan, as related to the river channel, is presented in its main features on page 11.

The Concrete Block Plant

We wish to call the attention of our readers to the account, on page 13, of the plant of the Price Bros. Co. for making the concrete blocks for the Miami River improvement. Mr. Harry Price, to whom the design of the plant is largely due, spent much time and thought on the working out of the details. Being familiar with the type of machinery usual in such work, he was enabled to carry his design to an unusually satisfactory degree of efficiency. One excellent point about the devices which he introduced, notably in the wire bending machine for making the reinforcement, is their simplicity. The wire bender was in fact home-made of picked-up scrap. It ought to be said also that in the handling of his men Mr. Price has done unusually well, a point to which we hope in the future to call further attention.

Contract for Track-Laying Let

The contract for laying track on the Big Four, Erie and the Ohio Electric Railways will be let on July 31st. The work will include the placing of about 100,000 ties, 110,000 cubic yards of gravel ballast, and 4800 tons of steel rails. The rail will be 90-pound except on the Ohio Electric, where it will be 70-pound. The gravel will be obtained from the valley bottom just above the Huffman dam site. It will be excavated by one of the Conservancy dragline machines.

The American Association of Engineers

The Dayton Chapter of the American Association of Engineers was recently addressed at the Engineers' Club by Prof. F. H. Newell, formerly Director of the United States Reclamation Service, and now head of the Department of Civil Engineering at the University of Illinois. He is also President of the American Association of Engineers. His theme in general was the value of the engineer to society and aroused much comment. The Association has developed a good deal of strength in Dayton, meeting, it would seem, a real need. Its object, that of promoting the business interests of the profession, is different from that of any other of the engineering societies, and there has been considerable discussion regarding it. One way of helping the business of the engineer is to educate the public as to its need of engineering service. That was one of the points made by Mr. Newell, and it was emphasized by Mr. Chas. H. Paul when a little later, at the same meeting, he was called upon to speak. The need of such education can scarcely be doubted, and the smaller municipalities especially furnish a seed bed for perfectly legitimate propaganda. The smaller cities do so many things ill which they might do well if they would employ a properly trained engineer, instead of a half baked one or none at all, that the possibilities in this direction offer a rich field. It may be objected to as advertising, and hence unworthy of the profession, but the objection will not hold. It is public education to a public need, and inures as much to the benefit of the people at large as it does to the engineering profession. In fact more. Such education might well be made one of the chief activities of the American Association of Engineers.

Superintendent Johnson Goes to the D. P. & L.

Mr. Roy Johnson, who has been Superintendent of the electric transmission line work of the District, has resigned his position, the resignation taking effect July 7, to accept a larger job with the Dayton Power and Light Company. He will be Superintendent of Line Construction, having charge of all that work for the company. He superintended the building of all the transmission lines at the Conservancy dams, and his new and bigger job is in itself a guarantee that the work was well done. We note his going with regret and wish him prosperity in the work he is taking up.

The Two Types of Outlet Structure at the Dams

The Conduits and Spillway Are Combined at Two of the Dams. They are Separate Structures at the Other Three.

It will be evident at a glance, to any one who looks at the pictures of the newly finished concrete structure at Lockington, shown in this issue, and contrasts them with the Englewood conduits shown in figure 3, or with the outlets at Germantown illustrated last month, that two entirely different types of structure are indicated. Englewood and Germantown show concrete tunnels nearly buried in the earth and rock of the valley floor. Lockington shows high massive walls and no tunnels at all. Yet in each case the dam is at practically the same stage of construction—the stream turned into its new channel and the hydraulic fill of the earth embankment just beginning or well begun. A discussion of the reason for the difference referred to may be of interest.

In connection with a dam four essential features should be recognized. The first is the dam itself, blocking the stream and storing the water in the basin or reservoir in the valley above, this basin constituting the second feature. The third feature is the outlet channel that carries the stored water through or around the dam to the valley below. On the way it may pass through a mill or power house, in which the water develops useful energy by turning water wheels. When thus used for power purposes, it will take water from the reservoir at a level nearly up to the top of the dam, as in the ordinary mill head race. In the case of retarding basins, however, like those of the Conservancy District, designed not at all for power, but entirely for protection, the outlet channel passes through the base of the dam. It is simply part of the regular river channel, and carries all ordinary flow without backing the water up the valley behind the dam at all.

The fourth feature is known as the "spillway." Its action is like that of a safety valve. It takes the water which the reservoir or basin cannot hold during flood seasons and discharges it below the dam. It is simply a broad, open channel, built of some material like stone or concrete which will resist the scouring action of the water. Since its object is only to take care of overflow, it connects with the basin or reservoir at a level near the top of the dam. In some cases the entire dam crest acts as a spillway, the excess water flowing over it and down the dam "apron" to the valley bottom below. In this case the apron must be built of materials which will resist wash. Such a dam is know as an "overflow" or "overfall" dam. An earth dam, however, like those of the Conservancy District, can never be of this type, since the rush of water down the apron would wash the material and might endanger the integrity of the structure. For an earth dam, therefore, a special spillway channel must be provided, which must take the water from the basin at a level sufficiently below that of the dam crest to prevent flood water ever overflowing the top.

One ideal type of spillway would be a structure entirely distinct from the dam, with inlet and outlet channels of its own, isolating the dam completely from danger of wash by spillway overflow. Nature sometimes, though rarely, provides conditions for such a spillway. The Germantown site exhibits such an instance. It is shown in figure 4. The

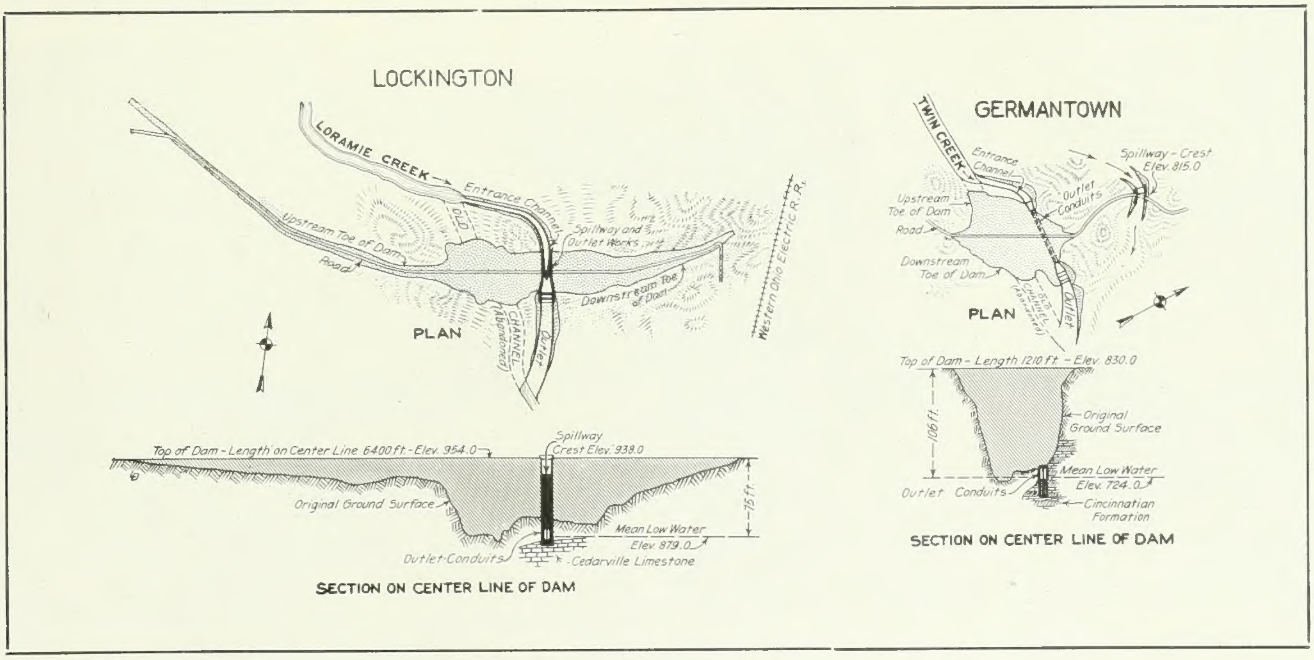

FIG. 4—PLANS ILLUSTRATING THE TWO TYPES OF OUTLET STRUCTURE

At Germantown the spillway (at the right) is entirely separate from the dam, with higher ground intervening. The channels leading the water to and from it are natural ravines tributary to the main valley of Twin Creek. Before water can overtop the dam it will flow up one of these ravines, over the spillway and down the other. At Lockington the spillway is directly over the conduits, the two being designed to be carried on the same foundation. See pages 5 and 6.

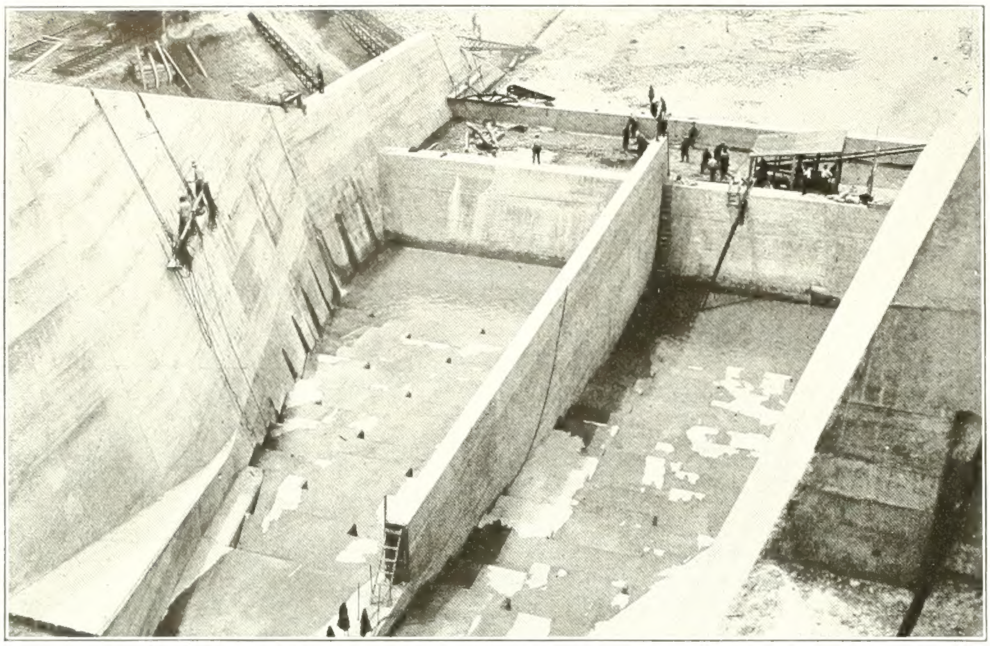

FIG. 5—LOCKINGTON OUTLET FROM TOP OF WEST WALL, JUNE 11, 1919.

The water, coming from the conduits, dscends the stairway into the hydraulic jump pool, which is divided into two halves by the partition wall as seen. The water will then go on over the first wall into the stilling pool, (where the men are standing) then on over the second wall into the outlet channel. The dark diagonal band at the lower left-hand corner marks the downstream end of the conduits.

spillway (at the right) is about 800 feet from the nearest point of the dam, with the hill between. The channels leading to and from the spillway follow natural ravines tributary to the main valley, which receive the flood water far above the dam and discharge far below it. Should a flood come heavy enough to bring the spillway into action, the hill would become an island, with its summit still thirty-five to fifty-five feet above the water. The spillway fits a natural saddle in the valley slope and the water flows over it on the natural bed rock.

At Englewood also the spillway is a separate structure, resembling that at Germantown. But nature provides here no intervening hill. The spillway will be located just at the west end of the dam.

Cases frequently occur, however, which make it best to carry the spillway channel directly across the top of the dam itself, and the question then becomes one of determining how to do this so as to secure the requisite safety at the least cost.

A considerable part of this cost is that of securing solid foundations. Now as already indicated, at all the dams of the District, there will be conduits to carry the ordinary river flow, and these conduits must also have solid foundations. It is evident that if the same foundation could be made to carry both structures, a considerable saving in expense might be made.

In its simplest form, this would amount to building a narrow section of the dam of concrete, or other similar material, pierced by the conduits at the bottom, and carrying the spillway channel at the top. And in fact, at Taylorsville, Huffman and Lockington this is the design adopted.

If the dam is very high, however, it is evident that the cost of building such a section entirely of concrete might be greater than that of building two separate structures, one for the conduits and the other for the spillway. The spillway in this case would naturally be at or near one end of the dam, where foundations could be found without going very deep. This is the case both at Englewood

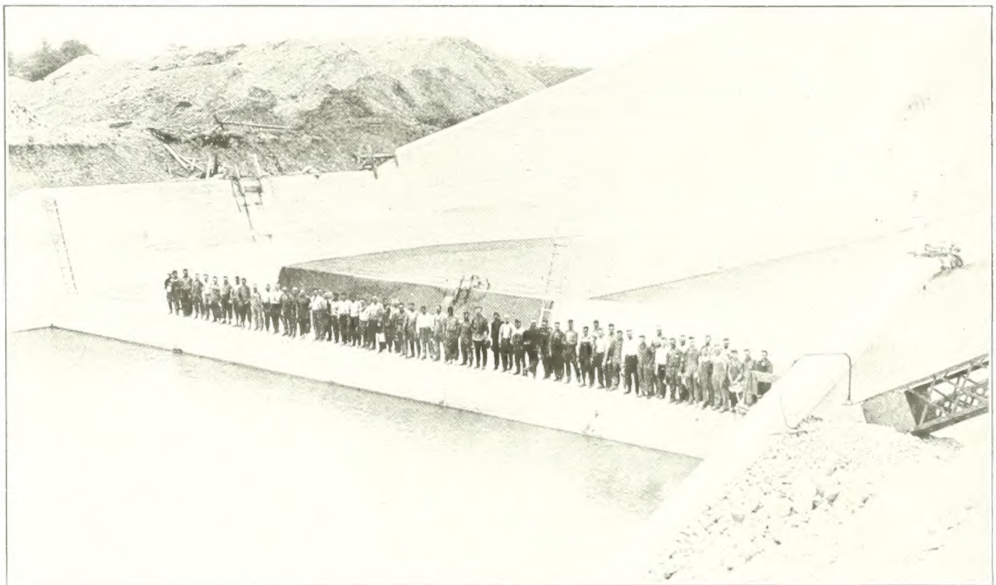

FIG. 6—THE MEN WHO DID IT

This photograph of the men who built the Lockington outlet was taken on June 11, 1919, the day that the waters of Loramie Creek were first turned into the new channel. The first of the water to come through is seen pouring over the left-hand half of the weir, (just back of the men) into the hydraulic jump pool. It is just ready to flow over the right-hand half of the weir.

and at Germantown, as has already been indicated.

Consideration of what has been said will make it clear that as a rule, other things being equal, considerations of cost will usually prescribe the combined structure for low dams and separated structures for high dams, and that at some intermediate height, varying with the particular case in view, the cost will be practically the same using either design.

The Lockington structure, illustrated in this issue, is of the combined type. It was at first planned to build the conduits and spillway here in separate structures, there being a natural spillway location across the low dike at the west end of the dam, where a natural ravine would lead the discharge back to the creek in the valley below. Borings made at this point, however, indicated that proper foundations could only be reached at a depth so great as to make the expense out of the question. A combined structure, conduits and spillway in one, was the economical solution.

A fuller discussion, going further into the engineering details of this subject at the several dams, will be given in future issues of the Bulletin.

The Outlet Structure at Lockington

Combined Conduit and Spillway Structure of Concrete, 525 Feet Long, 128 Feet Wide and 84 Feet High.

The Lockington dam is uppermost in the valley of all the dams of the District. It is being built across Loramie Creek valley, about a mile and a half above the junction of the creek with the Miami River. It will be an earth dam, about 7000 feet long, 440 feet thinck at the base, and 75 feet in height above mean low water, and containing 974,000 cubic yards of earth. The retarding basin above it, at maximum flood, will cover 3600 acres to an average depth of 17½ feet, equivalent to 63,000 acres 1 foot deep.

The great length of the dam is not due to an unfavorable site, but to the fact that to secure the necessary reservoir capacity, the dam had to be carried so high as to extend its ends in long, low dikes a considerable distance up the valley slopes. These dikes, less than twenty feet in height, constitute nearly half the length of the dam.

The dam is being built of earth by the hydraulic fill method. The outlet structure, recently completed, and illustrated in this number of the Bulletin, is built to carry the waters of Loramie Creek. It is already in operation, the creek having been turned through it on June 11. In its present form it consists essentially of two massive concrete walls, built at right angles to the dam and conforming to the cross section of the finished structure. Eventually a concrete cross dam will connect the two walls and block the space between, along the center line of the main dam. This will be pierced at the base by two openings side by side, rectangular in shape, 9′ wide and 9′ 2″ high, to carry the ordinary creek flow. This cross dam will not be carried to the full height of the structure, but will stop 16 feet short of it. This leaves a rectangular opening at the top of the dam between the two concrete walls, sixteen feet deep and about 77 feet wide, to act as a spillway. The building of the cross dam is postponed until the main earth structure is completed, in order to leave the amplest possible opening to carry flood waters during construction, which might otherwise back up sufficiently to overflow the partly finished earth work and injure it.

Since it would require a flood 40% greater than that of 1913 to cause water to run through the spillway at all, it is scarcely expected that this part of the design will ever come into use.

The working layout for the Lockington outlet structure was described in the Bulletin for November, 1918. The conditions were in several respects usually favorable. Bed rock existed only a few feet below the elevation of the bed of Loramie Creek,

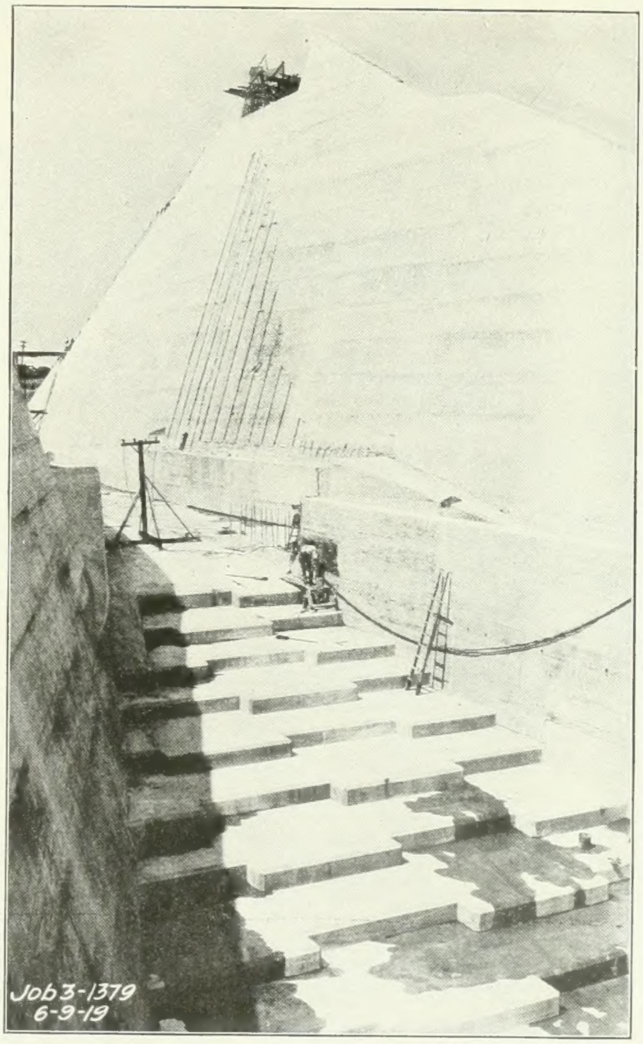

FIG. 7—LOCKINGTON OUTLET, LOOKING UPSTREAM

Taken from weir wall below, June 9, 1919. Loramie Creek was turned into the new outlet June 11. The vertical lines in the further wall are the keyways into which the concrete crossdam will lock.

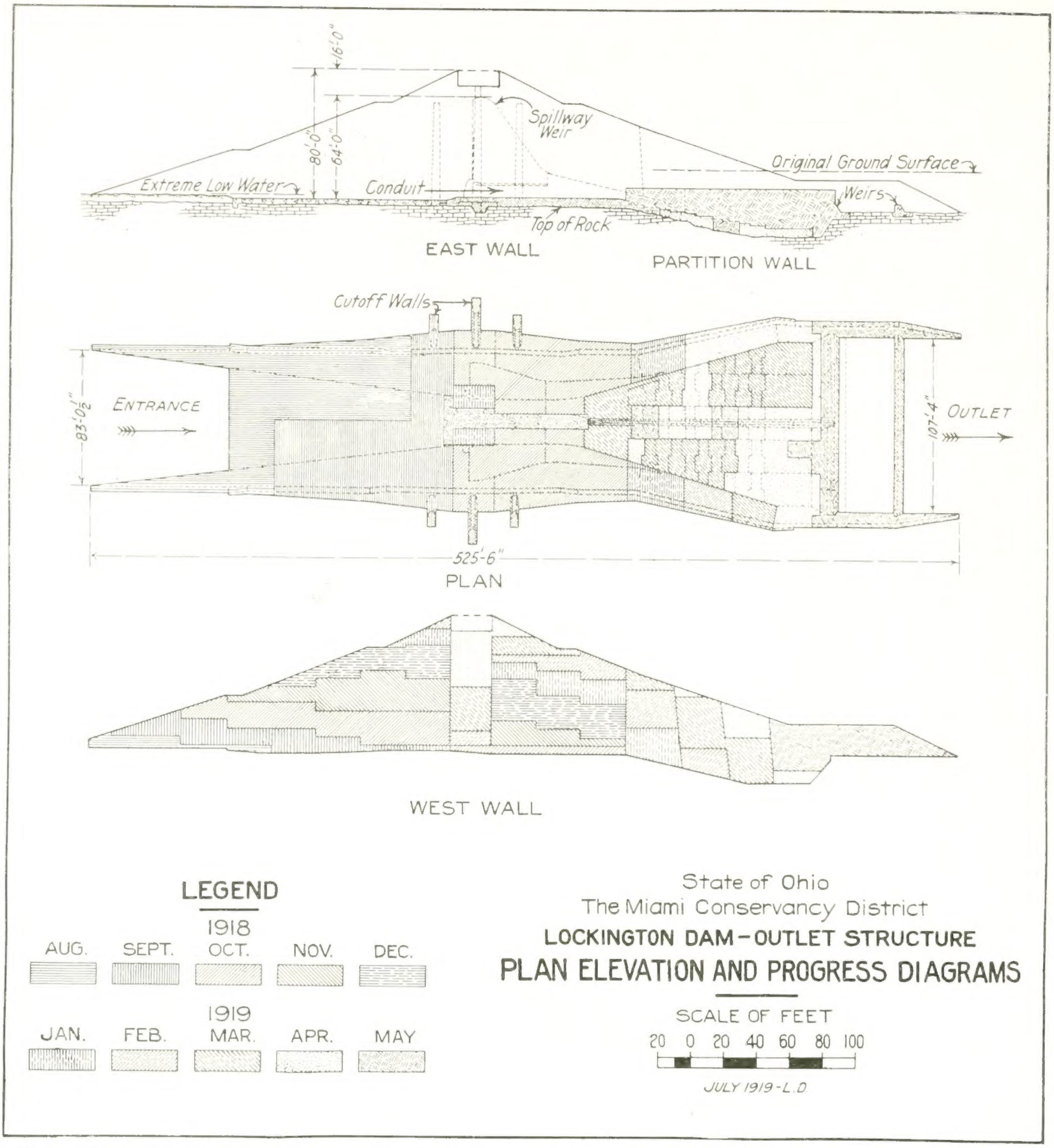

FIG. 8—PLAN, ELEVATION AND PROGRESS DIAGRAMS OF LOCKINGTON OUTLET STRUCTURE.

The west wall, the plan, and the partition wall in the upper figure, are hatched to indicate the month, during which each section of the concrete was built. Each month has its own peculiar style of hatching to distinguish it from the others. These are given in the figure under "Legend." The work of pouring the concrete began at the north (left hand) end in August, 1918, and the steady progress of the work can be clearly traced, month by month. The figures above were copied from those in the Office of Division Engineer Jones, and indicate how by such "progress diagrams" the men in the office follow the work in the field. The general method only is indicated above, not the details. In the office different colors are used for each month instead of different hatchings. The progress diagram of the east wall is omitted to show more clearly the outline (dotted line) of the spillway weir and crossdam.

almost level, and so firm that most of it needed only the cleaning off of the superimposed earth. Nowhere did more than a foot and a half of loose rock occur. A considerable part of the excavation necessary to reach the foundation was gravel, well adapted for concrete. This was piled into a stock pile east of the excavation.

The layout in practice worked well. The gravel washing and concrete mixing plant, similar to that at Germantown described in the April Bulletin, was at one end of the excavation, the gravel being transported to it in 4-yard dump cars drawn by a steam dinkey. The mixed concrete was carried from the mixer to the work in 1¼-yard bottom-dump buck-

ets on small platform cars drawn by a gasoline dinkey. The excavation not being deep enough to permit chuting the concrete by gravity into the forms from a track on the berm as at Germantown, the material was distributed to the forms in the buckets by two guy derricks. These had masts 120 feet high, with booms 105 feet long, operated by electric hoists. These lengths permitted buckets to be lifted and dumped up to the very tops of the walls, 84 feet above foundation footings. The derricks also handled the concrete forms. Water seeping into the excavation was removed by electrically driven centrifugal pumps, some of it being piped to the gravel washer for use in the screening and concrete mixing. Supplies were obtained over a spur track connecting with the Western Ohio Electric Railway, about 2000 feet east of the work.

The total length of the concrete outlet structure is 525 feet, its maximum width, outside to outside, 128 feet, and its full height from bottom of foundation 84 feet. This does not include the depth of the floor of the hydraulic jump pool below the bottom of the main wall. The structure contains at present 28,223 cubic yards. To finish it will require 3085 cubic yards additional, exclusive of the road work and concrete bridge over the spillway. This added yardage will be placed after the earth fill of the dam has reached about spillway level over its entire length.

The Concrete

Soon after concreting was begun tests were made of the materials, and the workability of the mixture, which led to the use, in general, of aggregate in the quantities shown in the following table, the volume of each size being given as used in one batch of concrete.

Sand under ¼″	13½ Cu. Ft.
Gravel over ¼″ and under ¾″	11 " "
Gravel over ¾″	22 " "

The measuring chutes were set to these capacities, securing thus an accurate and quick proportioning of the mixture. At times the chutes, and hence the proportions, were slightly changed to meet variations in the run of the gravel.

The cement was added in three different proportions, five, six, or seven full sacks to the batch of concrete, a full sack being considered to be one cubic foot. This gave the following proportions:

5 bag mix	1 :2.7 :6.6
6 bag mix	1 :2.25 :5.5
7 bag mix	1 :1.93 :4.7

The average size of a batch for the entire job was 1¼ cubic yards.

The five bag mix (1 :2.7 :6.6) was used in the interior and rear of the heavy walls, and in the bottom of some of the thickest walls. The six bag mix (1 :2.25 :5.5) was used for the entire wall whenever its thickness was less than about ten feet, and for the inner five or six feet of all walls thicker than this. For the submerged weirs, the partition wall, and the top two feet of the floors, the seven bag mix (1 :1.93 :4.7) was used. The concrete surrounding the outlet conduits was made of an especially rich mixture, 1 :1.5 :2.5. This was worked into place by persistent quaking of the mass, accomplished by the use of spades and boards moved vigorously back and forth. It was mixed to a consistency which would just give water to the surface after this continued working.

A typical analysis of the sand and gravel, as usually combined for use, is as follows, the cement not being included:

Size of Sieve	% Passing	Size of Sieve	% Passing
3 ″	88	No. 4	30
2½″	83	No. 8	21
2 ″	76	No. 14	11
1½″	62	No. 28	4.3
1 ″	50	No. 48	1.4
¾ ″	44	No. 100	0.8
½ ″	38	No. 200	0.5
¼ ″	32		

It will be noted that there is a deficiency in the small grains, of sizes passing sieves No. 14 to No. 48 inclusive; and an excess of the larger sand, passing Nos. 4 and No. 8 sieves. The excess was got rid of by means of a special screen added to the gravel screening plant, and which was described in the February Bulletin. The same article describes other special arrangements found advisable in the Lockington gravel washing plant. The general arrangements of the Conservancy gravel washing plants, including that at Lockington, is given in the April Bulletin.

The work at Lockington has been carried out under the supervision of Barton M. Jones, Division Engineer, C. H. Shea, Assistant Division Engineer, and G. E. Warburton, Superintendent.

July Progress on the Work

GERMANTOWN

The large Lidgerwood dragline has finished excavating the inlet channel and on June 25 the water was turned through the conduits.

On June 30, the hydraulic pumping plant was put in operation. One pump is being used at a time, the material being discharged at one toe of the dam and then at the other, the slopes being thus carried up alternately. The material is being placed at present in the area between Twin Creek and the north side of the valley. Twin Creek serves as the source of water supply, a sump having been cut from the creek to the hydraulic plant. It is necessary to pump all of the water, no gravity method for water supply being available.

Excavation for the spillway has been in progress during the past month. This work is being done by separate contract.

A small earth dam will be placed across the ravine near the entrance to the spillway in order to provide a convenient place for wasting the earth excavated from the spillway.

Arthur L. Pauls, Division Engineer.

July 17, 1919.

ENGLEWOOD

On June 30 the lower cofferdam at the outlet conduits was breached to permit the river water to enter the conduits. The streamflow, however, will not be diverted until some time this month, when cofferdams at the upstream and downstream toes of the dam will be built and the river

bed unwatered for examination and preparation for embankment.

Work on the cross dam is progressing favorably. On July 14 a twelve-ton steam roller was put into operation, compacting the embankment of the center portion in six-inch layers. The upstream and downstream portions of the cross dam are now being pumped into place along with the hydraulic fill.

A total of 128,000 cubic yards of material was placed in the dam during the month of June. Of this, 113,000 cubic yards was hydraulic fill, pumped into place, and 15,000 cubic yards deposited in the cross dam by means of the large electric dragline. The total embankment to June 30 was approximately 440,000 cubic yards, or 12½ per cent of the entire dam.

The graveling of Highways 4 and 5 is progressing favorably.

H. S. R. McCurdy.

July 15, 1919.

LOCKINGTON

One dredge pump is now running day and night shifts, pumping the material a distance of 1,500 feet through a 12-inch pipe to the lower toe of the dam in the old creek channel. At present most of the material is being taken from the overflow ditch, which will lead from the sump to the entrance channel. Rocks too large to pass through the pump are being hauled from the sump and placed in the upstream toe of the dam.

The cut-off trench has been excavated by the larger Lidgerwood dragline, beginning at the concrete outlet structure and reaching to a point about 1000 feet west of it. For most of the distance the trench reaches bed rock. The excavated material, being suitable, is used to build the upstream toe of the dam. To date about 25,000 cubic yards have been placed in this dike.

The Class B Lidgerwood dragline has built the west approach to the bridge over the outlet channel and is now shaping up the lower end of the channel banks.

Part of Road No. 9 is being graded preparatory to graveling. The culverts on Road No. 10 and most of those on Road No. 9 have been built.

Barton M. Jones, Division Engineer.

July 18, 1919.

TAYLORSVILLE

The work of the Lidgerwood dragline in the outlet channel has been practically the same as reported last month, as the upstream progress of the working face at present is only about 40 feet per month.

The cross dike on the west bank of the river is finished except for a little settlement that will be made up with teams. A track has been laid from trestle No. 2 along the cross dike to the first berm on the lower toe of the dam, and a blanket of rock from the outlet excavation is being dumped on the lower toe.

A borrow pit is being opened up for the sluicing east of the inlet channel as extra earth is needed in the dam and the working face in the inlet channel is too short for efficient handling.

The gravel washing plant has been used to wash and screen the gravel for the concrete arch bridge over the B. & O. R. R. and for the most part worked very satisfactorily.

The concrete bridge has been poured all except the handrails.

The progress on the new cottages has been very slow because of delayed shipments of lumber.

O. N. Floyd, Division Engineer.

July 16, 1919.

HUFFMAN

The south half of the excavation for the outlet channel, from the lower end of the concrete to Mad River, has been completed. The material from this excavation has been loaded upon cars and hauled out to the Big Four and Erie Railroad fill. The dragline has started back, excavating the north half of this outlet channel, the material being placed in a fill just below the downstream toe of the dam.

The concrete in the main part of the two walls of the outlet works has been placed, and with the exception of a few sections the floor has been completed from the upper end down to the hydraulic jump pool. A little over 6,000 cubic yards of concrete were placed during the month of June, and a total of 20,700 cubic yards have been put in to date.

Work on the erection of the hydraulic pumping plant has been in progress during the past month.

C. C. Chambers, Division Engineer.

July 16, 1919.

DAYTON

Channel excavation to date amounts to 428,000 cubic yards. A total of 354,000 cubic yards has been placed in levees and spoil banks, including 60,000 cubic yards of Contract No. 41. In accomplishing this work a total of 728,000 cubic yards has been handled.

Concrete is being placed in the extension of the storm sewer at McKinley Park. This construction has been difficult because of the large quantity of mud and trash which had to be excavated from the old hydraulic outlet before the foundation material could be placed.

The caterpillar dragline is engaged in the work of lowering the 20-inch water main which crosses the bed of the Miami River from Lawrence Street to Belmont Park. In order to place the main below finished channel grade it has been found necessary to lower the pipe for a length of over 300 feet.

The Germantown gravel washing plant has been brought to Dayton and is being erected near the mouth of Wolf Creek.

The dry dock at Sunset Avenue has been put in operation, one of the 40 ft. x 120 ft. scows being now in the dock for repairs.

Price Bros. have completed about 75,000 concrete blocks for use in the flexible revetment.

C. A. Bock, Division Engineer.

July 19, 1919.

HAMILTON

The total amount of material excavated by the two draglines to July 1 was 665,000 cubic yards. The electric dragline has been taken through the Columbia bridge and will take out the center cut between the Columbia bridge and the railroad bridge. From June 7 to June 29, inclusive, 18 working days, the machine excavated and loaded on cars 62,000 cubic yards, or an average per day of 3,444 cubic yards.

The steam dragline, Bucyrus Class 14, is continuing work on the tail-race at the Ford plant.

Work on the Wood street sewer is nearing completion. The Front street sewer will be started as soon as the work on Wood street is finished.

The placing of the asphalt pavement on Wood street and Buckeye street has been awarded to the Andrews Asphalt Paving Co.

Good progress has been made on the crossing under the B. & O. R. R. The excavation under the tracks has been brought to grade and the railway company's work on the trestle has been practically completed. This crossing is to enable dump car trains, loaded with materials excavated from the river north of Main street, to reach the low ground near the Ford plant where the material must be dumped.

C. H. Eiffert, Division Engineer.

July 19, 1919.

RAILWAY RELOCATION

B. & O. Relocation. The grading on the B. & O. Relocation is 95 percent completed. Condon & Smith started work in the last cut the middle of July and will finish all grading about the first week in August. All surfacing is finished from the south end of the relocation to Taylorsville, and the subgrade is ready for track laying. Roberts Bros. have had a small crew, under Superintendent Sutherland, setting up their track laying machine at Siding No. 1, about two miles north of Dayton, and are ready to start laying track. All of the new rails and 40 percent of the ties have been unloaded. Vang Construction Co. have loaded their outfit and shipped it out. Kahl Bros. Construction Co. are now finishing the levee just north of Taylorsville. The railroad company has started to elevate the tracks from Needmore Road to Leo Street, a distance of approximately two miles. The raise is required by the Conservancy plans because of the elevation of the Miami River bridge to conform with the improved levees. The raise is six feet at this point, and diminishes uniformly to meet the old grade at Leo Street. From the bridge north

it rises on a 0.2 per cent grade to meet the relocation a little north of Needmore Road. The cost of elevating the main line, and that of one sidetrack north of Miami River bridge, is to be borne by the District. All other track work, and the elevating of the bridge structure, will be borne by the railroad company.

Big Four and Erie Relocation. The excavation of the big cut at Huffman Hill has progressed so that of the 680,000 cubic yards total, only 50,000 cubic yards remain. The cut is now being taken down to subgrade. The finishing of the embankment and the other cuts is progressing as this excavation is being made. The Ohio Electric and Big Four cuts cross the Springfield Pike, and because the excavation is now being made through the present highway, it is necessary to divert all highway traffic. The pike will be relocated so as to parallel the railroads. A portion of it has been constructed and the remainder will be completed as soon as the traffic on the new railroad line is in operation. At Harshman the channel change is almost completed. The Walsh Construction Co. is doing this work.

East of Fairfield, George Condon is excavating the last cut, the material in which is gravel. He is moving this at a rate of 50,000 cubic yards per month.

Preparations for tracklaying and ballasting these two railroads are being commenced.

Ohio Electric Relocation. The grading between Mud Run and Carlisle Junction is rapidly taking shape. The two stiff leg derrick "draglines" are doing excellent work. The masonry for Mad River bridge is well under way. A steel sheet piling cofferdam was used on this work and the footing of the west pier has already been placed. The Mud Run trestle and Smith Ditch concrete trestle are about 50 percent completed.

McCann, who has the contract between Fairfield and Mud Run, has installed a revolving steam shovel just west of Osborne and is handling the excavated material from the shovel with teams.

Albert Larsen, Division Engineer.

July 19, 1919.

RIVER AND WEATHER CONDITIONS

The rainfall in the Miami Valley during June was well distributed through the month and was less than normal in amount. Consequently no surface runoff occurred in any of the drainage areas. The river stages fell slowly but continuously throughout the month at all stations.

The total rainfall at the District's stations varied from 1.26 inches to 3.56 inches. The precipitation at the Dayton U. S. Weather Bureau Station was 2.59 inches, or 1.37 inches less than normal, bringing the accumulated deficiency since January up to 2.55 inches.

At the Dayton U. S. Weather Bureau Station the mean temperature for the month was 75.6° F., or 3.5° above normal; there were 10 clear days, 14 partly cloudy days, 6 cloudy days, and 11 days on which the precipitation exceeded 0.01 of an inch; the average wind velocity was 7.5 miles per hour, the prevailing direction being from the southwest; and the maximum wind velocity for five minutes was 50 miles per hour from the northwest on the 16th.

Ivan E. Houk, District Forecaster.

July 22, 1919.

The Problem of the River Channel Through Hamilton

Difficulties Due to Heavy Flood Flow and a Constricted Channel Through a Built Up District.

The problem of flood control at Hamilton was more difficult than at any other city of the valley. Relatively, the destruction there in 1913 was greater than at any other point. The flood was greater than at Dayton in the ratio of 7 to 5. It amounted to 350,000 cubic feet per second, moving at high ve-

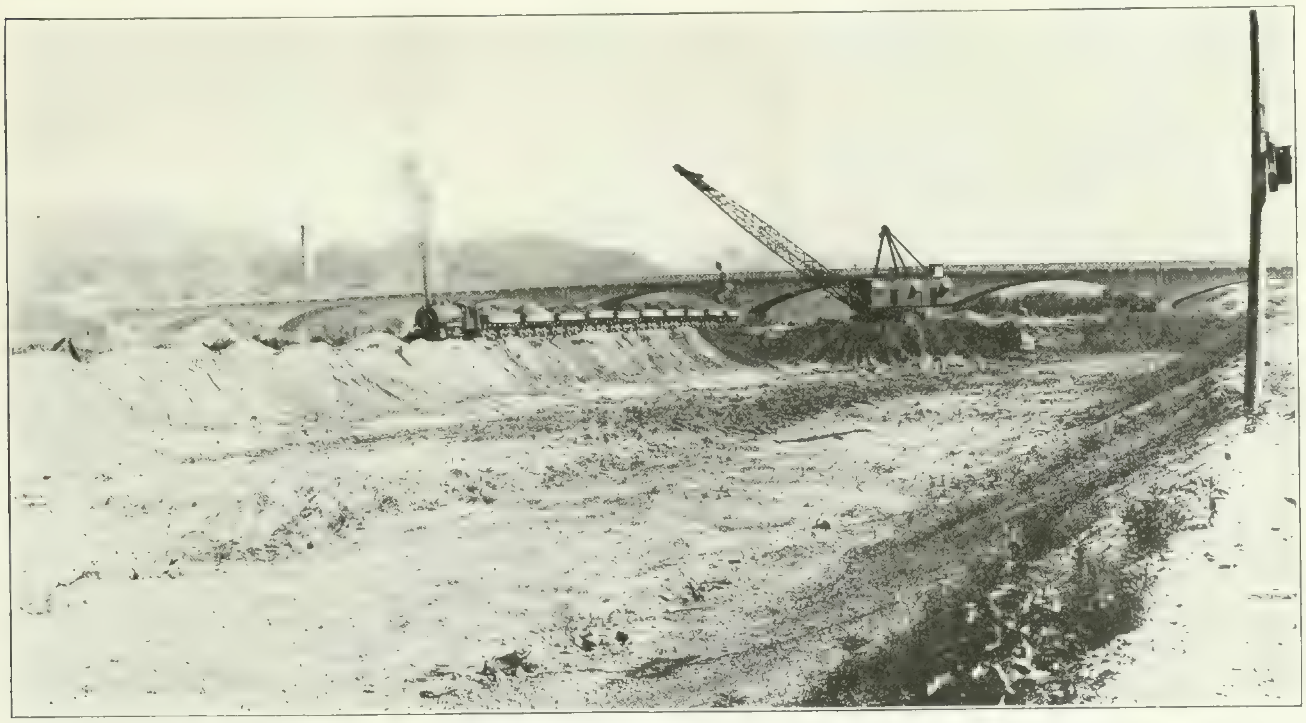

FIG. 9—EXCAVATING IMPROVED MIAMI RIVER CHANEL BELOW COLUMBIA BRIDGE, HAMILTON

The excavator is a Class 24 Bucyrus dragline, with 100 foot boom and 2½-yard bucket. The cars are 12-yard cars drawn by a 48-ton locomotive. The material is dumped to fill an extensive low area in Peck's Addition to Hamilton. The slope at the right is the bank slope, with a berm and a levee (not seen) to right of it. The material where the train is standing will be removed later. The river flows in its low water channel beyond. Taken July 3, 1919.

[illegible] the city it covered most of this area to a depth of ten [illegible] deep. The drop through the city was steep—twen- [illegible] and the current was correspondingly swift and violent. In places the slope of the water was five or [illegible] rushed down the incline like a stream down a rapid among boulders, except that the stream here was a mile-wide flood, and the boulders were residences [illegible] was over two hundred.

Such facts make vivid the truth which the calcu- [illegible] for economically by simply enlarging the river chan- [illegible] considerable distance flows through a restricted [illegible] dustries. To secure protection by channel improvement alone so many of these would have to be wrecked to provide the necessary width as to make the cost insurmountable. To carry the river around [illegible] impossibility, since the city occupies the entire val- [illegible] gether, with the half dozen smaller cities to be protected, left no question that the practical solution was by a joint project of protection such as was finally adopted, by which a large part of the flood waters would be held back in retarding basins be- [illegible] leaving only so much flow to be carried by the enlarged river channel as, in connection with the cost of the retarding basins, would be found most economical. At Hamilton, the amount of water thus left to be carried by the improved channel, was cal- [illegible]

Even so, the problem at Hamilton remained a very [illegible] stricted width at the sites of important manufacturing plants, above referred to, between which the river flows. From the building of the Champion [illegible] Niles Tool Works was only 420 feet. Between the banks here the distance was only 390 feet. At Dayton the narrowest corresponding width was 550 feet. Consequently certain buildings here must be [illegible]

A crucial point was at the High-Main Street bridge. This had been designed by the City without being made to conform fully to the needs of the Conservancy plans. It was a newly built structure of concrete arches on concrete piers and abutments. It set limits to the improved waterway in height, width, and depth. The distance between the abutments was only 501 feet, limiting the new channel to that width. To increase this meant to wreck the west abutment. The depth of the improved chan- [illegible] the bridge piers during floods. The extent of the problem may be indicated by the fact that the maximum capacity of the old channel at this point was [illegible]

[illegible] channel, or by widening it, or by building levees, [illegible] explained, was limited by the height of the bridge [illegible] width was made 500 feet at the bridge and for some distance above it. The new depth was made from [illegible] water still three feet below the tops of the levees. On the east bank above the bridge, where the need for protection was greatest, this height of the levees [illegible]

The widening involved the purchase of a strip of land 150 feet in breadth, extending nearly a mile [illegible] which had to be wrecked. Among these were parts [illegible] and the Black-Clawson Co. The wreckage also in- [illegible] Hydraulic Co. The cost of the strip was upwards of three quarters of a million dollars.

The width of the channel thus obtained is not uniform. The improvement begins at the mouth of [illegible] The width of the channel here, from foot of [illegible] gradually to 540 feet at Black Street bridge, about a quarter of a mile below, and to 520 feet opposite the plant of the Champion Coated Paper Co., a little farther down. This 520-foot width is maintained for 3,000 feet further, to the High-Main Street [illegible] Railroad bridge, about 1,200 feet further down. The 620-foot width is then maintained to the lower end of the improvement. The total length of the improved channel is 13,000 feet.

The widening of the channel below the High- [illegible] flood at maximum, as calculated, will be reduced [illegible] cured is considered to be well worth the cost.

With the diminished quantity of water and the enlarged channel as described, the velocity of the river [illegible] quite high. It will be highest, of course, where the channel is narrowest, along the 520-foot width, and especially at the Main Street bridge, where part of even this width will be occupied by the bridge piers. [illegible] slightly, so that at maximum flood the water will be a foot higher above the bridge than below it. It is in the drop of the water at this bridge that the highest velocity will be obtained.

The effect of such an increase in velocity was discussed in the article, printed in the May Bulletin, on erosion and deposit of sediment. The principles there discussed were in fact well illustrated by the river at Hamilton during the 1913 flood. Squeezed into the narrow neck between the Champion Coated [illegible] simply concentrated an increased erosive power on the narrow section and scooped out the river bottom into a hollow six or seven feet in depth. By a simi-

lar action at the High-Main Street bridge the bottom was deepened eight or ten feet. Finally, in passing around the only bend of magnitude in the city, just below the B. & O. Railroad bridge, the water swung to the outside of the curve, and scooped the bottom out in a third pool along the west bank. In each case the deepening was several hundred feet in length.

In the improved channel these tendencies cannot entirely be eliminated, but of course, with the flow reduced from 350,000 to 200,000 cubic feet per second, and with diminished velocity, they will be greatly reduced in magnitude. Nevertheless, at the High-Main Street bridge, where the construction and velocity are greatest, the case requires special attention.

It will be noted that at each principal constriction in width of channel, during the 1913 flood, the water deepened its bed. It effected a compensation for its restricted width by increasing its depth. Faced with the problem at High-Main Street bridge, the Conservancy engineers did the same thing. They deepened the channel under the bridge two feet below the grade, as established above and below, thus providing the necessary increase in capacity. To stop deeper wash, however, such as might undermine the bridge piers, the plans provide for driving a wall of interlocked steel piling ten feet deep into the river bottom just below the bridge, with the top of the wall just at the surface of the deepened channel.

With the improvements indicated, the velocity of the water at maximum through Hamilton will still be high, sufficient to produce strong effects. It will be able to roll along the river bottom loose stones six or eight inches in diameter, or even larger, as experiments and observations have shown. Damage from such action must be guarded against. This could be effectively done, of course, by paving the bed of the river with concrete, but the cost of this would be approximately $900,000.00. This expense was not considered necessary, chiefly for the reason that if erosion of the river bed should occur during a flood, the effect would be simply to deepen the channel and hence to increase its flood carrying capacity. The trouble thus tends to be self-curing. The deeper the bottom is eroded, the more capacious the channel will become, till a point will be reached where erosion will cease, since the more capacious the channel, the slower the water will flow. As the channel at Hamilton is nearly straight, this deepening may take place without the formation of serious gravel bars. If bars do form they must be removed as part of the cost of maintaining the improvement.

But although erosion of the bottom may thus be a gain rather than an injury, this is not true in case of the banks. These must be very carefully protected. The levees and banks will be lined throughout the narrow section with monolithic concrete paving six inches thick. At the foot of this pavement a line of piling will be driven, strong posts three feet apart, driven eight feet in the earth, their heads embedded in a continuous concrete wall sunk in the river bed. The concrete paving is then continued out from this wall along the river bed thirty-five feet toward the center of the stream, where it ends in a second concrete wall. This wall is anchored at every three hundred feet of its length to a strong fence of interlocked steel sheet piling running toward the bank, sunk ten feet in the river bed, anchored to both walls, and turning a short distance down stream along the inner walls. Thus each bank and edge of the stream bed is armored with concrete for a total width exceeding ninety feet, reinforced by strong timber posts, and by two concrete walls, with steel crosswalls under the stream bed at every three hundred feet, the entire width of the concrete being reinforced and tied together and to both walls by a mesh of steel wire.

It seems scarcely possible that river banks thus armored can be scoured out. Even should scour begin, it would be effectually stopped. The inner edge of the concrete armor might in fact be undermined to a depth of several feet, yet the integrity of the protection would remain unimpaired. For the concrete paving along the bottom, where dangerous wash would occur, consists of a flexible mattress of concrete blocks woven together by steel cables. This mattress would settle into any depression which scouring might create, and take the shape of the new bottom. Thus the paving, even if undermined, would be still unbroken, anchored by two steel cables through every block to the still solid structure next the bank. The entire bed of the river might be deepened by scour several feet, yet the banks remain undisturbed.

Consideration of the foregoing will make it clear why the Conservancy engineers, in solving this problem, did not think it necessary to go to the expense of paving the entire channel. The protection described is believed to be sufficient to guard against the severest flood.

Making Concrete Blocks for Miami River Revetment

Some Ingenious Devices and an Efficient Layout.

In order to prevent wash by the current, a considerable length of the new river banks will be covered with a lining of concrete. This lining will extend also to cover a thirty-five-foot strip of river bed adjacent to the banks. At the lower edge of this lining, or "revetment," especially around the channel curves, on the concave side of the curve, there is danger that the concrete will be undercut by the current, with resulting damage, and possible danger of cutting through the levee. If the lining could be made in the form of a flexible mattress, so that when wash began, the mattress could settle down to protect the threatened point, the "stitch in time" would be taken against further trouble.

Such a flexible revetment might be made of concrete bricks or blocks, laid flat on the shore like bricks in a wall, if the blocks were linked together by steel hooks. Cheaper and better, two holes may be cast in each block and the blocks strung together by galvanized steel cables passed through the holes. If the blocks break joints, we shall thus get the equivalent of a woven structure, in which the blocks

are the woof and the cables the warp. Such a structure was adopted for the Miami River flexible revetment.

About 400,000 of the blocks will be required, of a size, 1 ft. x 2 ft. x 5″ in thickness, the narrow faces all beveled ¼″ from their center line each way and the holes located 6″ from the short edges of the block (See block on top of car, Fig. 10). The holes are ¾″ in diameter and take a ½″ steel cable. The problem was the economical casting of such blocks.

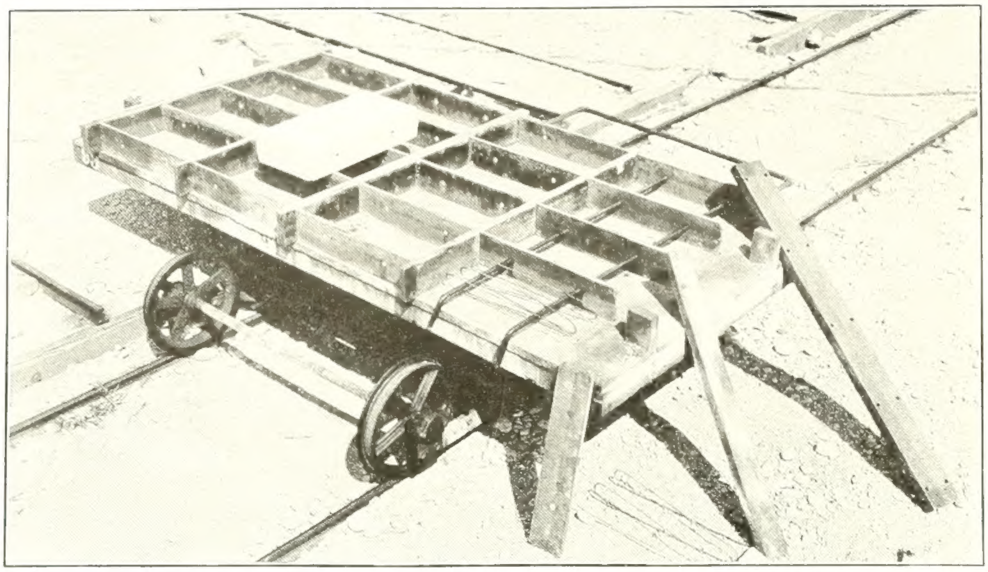

FIG. 10—CAR WITH 16-CELLED CONCRETE FORM

See page 14 for explanation

The plan of the forms for the blocks, as developed by Mr. Harry Price, of Price Bros., Contractors, who are doing the work, is shown clearly in Fig. 10. For economy in handling, the blocks are molded on small flatcars, 16 blocks to the car, remaining on the cars from the time they are cast till they are unloaded, a finished product, in the storage yard. The 16-celled form is built up on the floor of the car, which forms one face of the block. The cells are formed by longitudinal and cross pieces as shown, forming the partitions, 2 tenons on each end of each longitudinal piece slipping rather loosely into corresponding mortises in the cross pieces, which are longer. A partition piece of each kind is shown leaning against the end of the car. The center cross piece is bolted to the car platform; all the other pieces are loose.

The forms are built up by slipping the tenons of five of the short partition pieces into the corresponding mortises in the fixed cross piece, then laying the next cross partition piece in place, slipping the mortises over the tenons of the short pieces already in place. This completes one middle section of four cells. The other middle section and the 2 end sections are similarly built up. The whole form is then tightened by cross blocks and wedges inserted between the two end cross pieces and the projecting studs seen at the ends of the car platform. The top of the form is left open to receive the concrete, the freshly poured block being struck off with a broad trowel but not finished. The partition pieces are lined with sheet steel, number 16 gage and rustproof. The holes through the blocks are formed by iron rods, slipped through holes in the form partitions as shown in the figure. Rods and partition faces are oiled with straw paraffin oil to prevent the concrete from adhering. The rods are removed while the blocks are still a little green. The blocks cure for 24 hours on the car, after which the forms are taken apart by knocking out the wedges and removing the partition pieces and the finished blocks, one by one.

The movement of the cars in relation to the general arrangement of the plant is shown in Fig. 11. Empty cars with forms made up receive the fresh concrete from the mixer and are pushed on to a rolling platform which moves along the transfer track at the left to a point opposite one of the tracks in the curing yard, to which it is then transferred, all the pushing being done by hand. (Short sections of rail on top of the rolling platform are placed

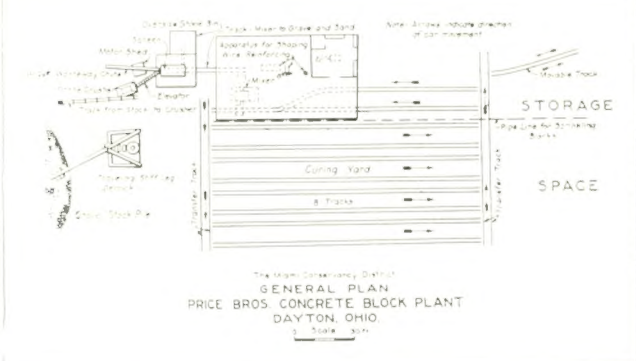

FIG. 11—GENERAL PLAN, CONCRETE BLOCK PLANT

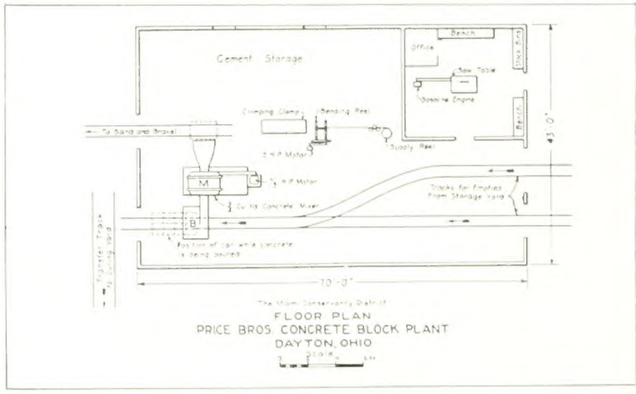

FIG. 12—INTERIOR PLAN, CONCRETE BLOCK PLANT

to align with the tracks in the curing yard and on the same level.)

The curing yard contains 8 tracks, each capable of holding 13 cars. At the end of a day's run this yard is filled with from 81 to 83 cars, all loaded with green blocks. The next day these cars, by way of the second transfer platform, (two of these being in use) are run over the transfer track at the right to the movable track, (so marked in Fig. 11) in the storage yard, over which they pass to the point where they are unloaded to await transportation to the river levee. The blocks remain in the curing yard about 24 hours. The regular day's run is 81 cars, or 1296 blocks, enough extra carloads being cast during the week to bring the average up to 1300 blocks per day. After the blocks are unloaded, the forms are taken apart, cleaned, oiled, set up again, and returned to the plant for a fresh load of blocks.

The finished blocks are kept wet for several days by a sprinkling device made by running down the length of the storage yard a light weight pipe with slots sawed in its upper quarter at proper intervals.

Cement for the concrete is brought by truck and unloaded by hand. The gravel is obtained from the bed of the Miami River. It was deposited in a stock pile on the bank by a dragline excavator, the plant being close to the river. The gravel is taken from the stock pile by a traveling stiff-leg derrick with one-half yard clam shell bucket (see Fig. 13), and dropped into a car running on a track on a trestle. The car dumps into the hopper of a stone crusher, from which an elevator takes the crushed material to a gravel screen which separates it into two sizes—coarse aggregate, 2″ to ¼″, and sand, all below ¼″. The screened material passes by gravity to bins and thence to hopper cars which carry it along a track to the receiving hopper of the concrete mixer.

From the mixer (M, Fig. 12) the fresh batch pours into a mortar box B, one batch making about a car and a half of blocks. The car with the form is rolled under the mortar box. The fresh concrete runs from the box into the forms through four gates, properly spaced to fill 4 cells of the form at a time. Four such pourings fill a car.

The fresh blocks, after being run to the curing yard, are thoroughly spaded by a special spade made by straightening the shank of the blade of a garden hoe. They are then rough-finished by striking with a broad trowel as already stated.

The reinforcement for the blocks is of No. 7 steel wire, shaped as shown in the picture, Fig. 10. The reinforcement is laid into the form as shown and slightly lifted from the bottom as the block is being poured, in order to bring it into proper position, the fresh concrete being stiff enough to hold it in place.

The reinforcement is made from the wire by a simple and ingenious arrangement sketched in plan as part of Fig. 12. The wire coming from the supply reel passes over three grooved wheels as shown to take the bend out. It passes thence to the bending reel made out of parallel gas pipes attached to a pulley rotated by an electric motor. This reel forms it into a somewhat flattened coil. The crimping clamp is then rolled forward on its rails (not shown) and its jaws bring the coil to final flatness. The coil is then removed from the reel and cut into sections of the requisite number of turns to give it the final shape seen in Fig. 10.

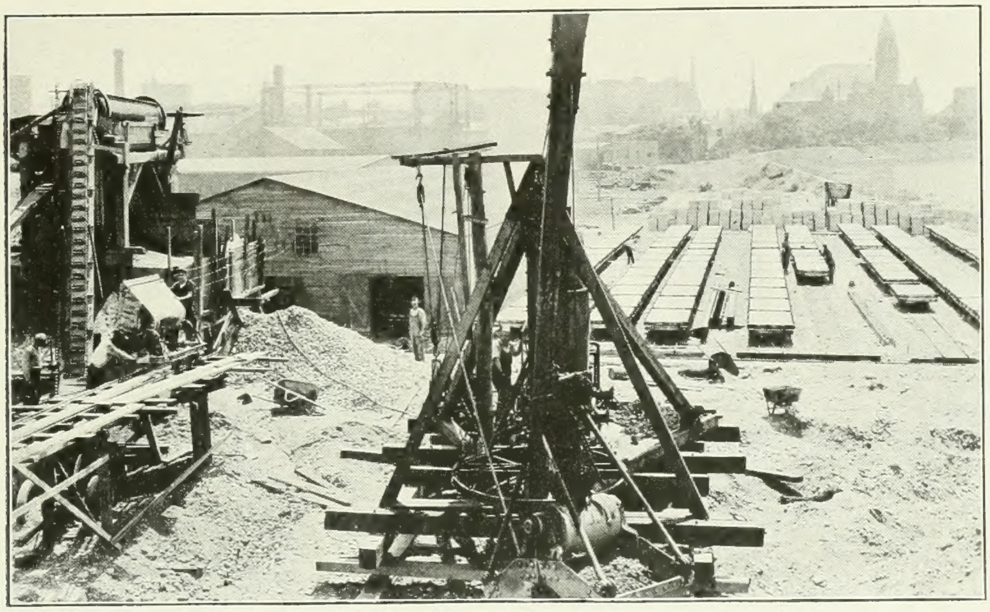

FIG. 13—PRICE BROS. CONCRETE BLOCK PLANT

Clamshell in foreground loads gravel from stock pile (not seen) into car shown dumping into rock crusher at left. Elevator belt to left of car takes crushed gravel to screen above, whence it passes to bins below and then by cars to mixer. Curing yard at right. Storage yard in distance. Mixer, etc., in house at left.

The rock crusher is a number one jaw crusher, built by the Wastern Wheeled Scraper Co. The mixer is a Koehring batch mixer of 21 cubic ft. capacity, run by a General Electric 7½ H. P. motor A 2 H. P. motor runs the wire bender, a 3 H. P. motor the gravel screen, and a 7½ H. P. motor the rock crusher. All the electric motors are of the induction type and take current from the Dayton Power & Light Co.'s alternating current line, the plant being within the city limits of Dayton.

The labor required is as follows: wire bending machine, one man; trucks bringing cement, 2 men; derrickman; crusher and screen, 2 men; sand and gravel car to mixer, 4 men; mixer, 2 men; filling forms, 2 men; transfer car, 1 man; spading and finishing blocks, 2 men; cleaning, oiling, and setting up forms, 4 men; unloading blocks, 3 men. Add to these a superintendent, an inspector, a general utility man, and a night watchman. This totals 28 men. Much of the work has been done with 24 to 26 men.

The plant is operating very successfully and economically, and is turning out an excellent product. The contract price for the first hundred thousand blocks is 20 cents per block; for additional quantities, 16 cents per block. Counting the expense of gravel and use of rock crusher, both of which are supplied by the District, this makes the average cost between 17 and 18 cents per block. The turnout up to July 26 was 87,500 blocks, just half the number required for the Dayton river improvement. Hamilton will require 225,000. The plant will be dismantled and moved to Hamilton to make them.

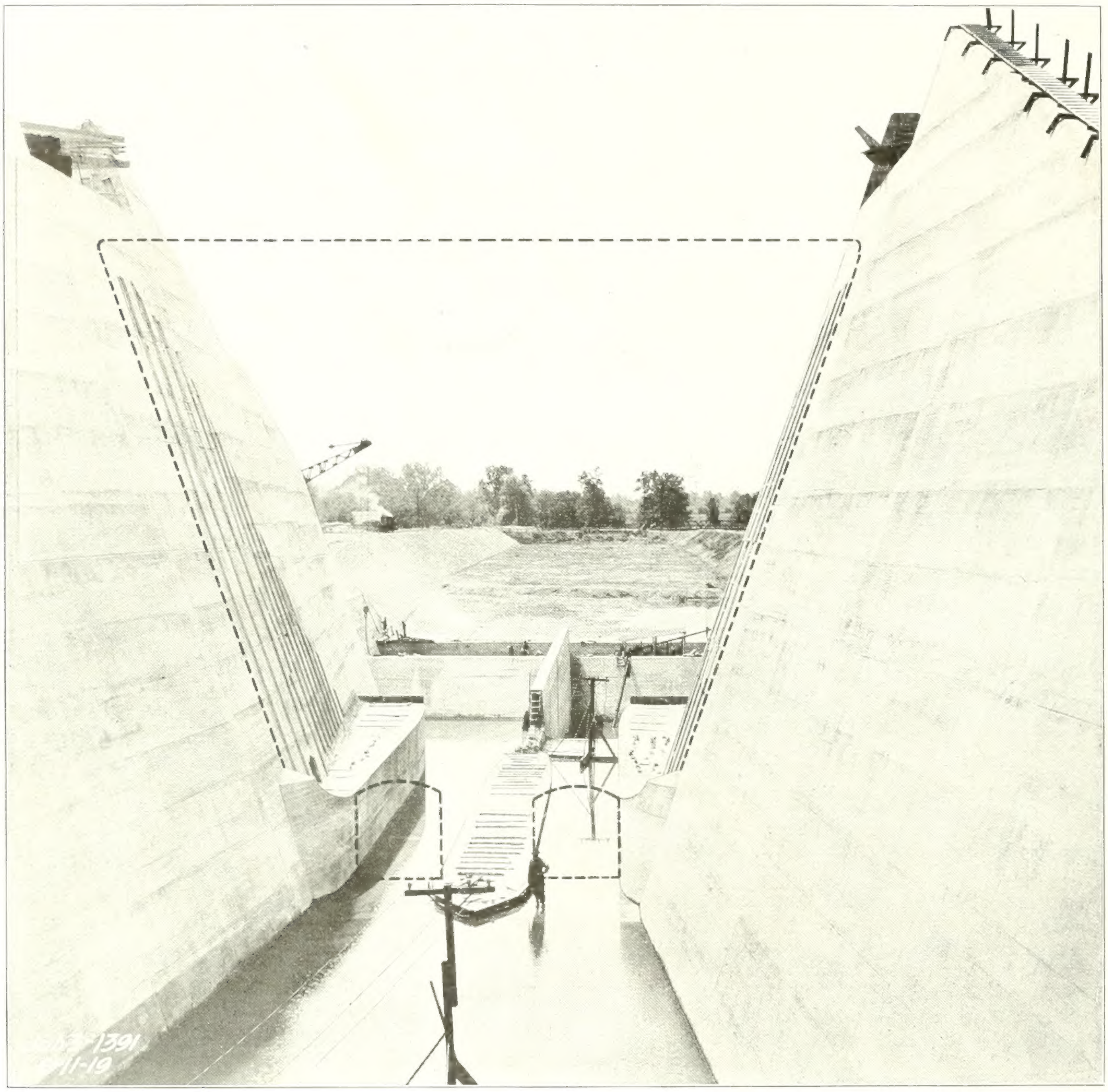

FIG. 14—LOCKINGTON OUTLET STRUCTURE, FROM TRESTLE IN FOREGROUND, FRONT COVER PICTURE, JUNE 11, 1919.

The view is down stream. The space between the walls, when the dam is finished, will be blocked by a concrete crossdam between the dotted lines shown at the side and extending up to the dotted line at the top. The space above the dotted line is left open for the spillway channel, which will take the overflow in case of extreme flood. This channel will be 16 feet deep and about 77 feet wide on the average. The walls at the top, forming its sides, now appear notched. These notches will be filled up with concrete. They indicate the position of the ends of a concrete bridge which will cross the spillway, carrying a highway which will be built across the dam. The vertical grooves in the walls, just beyond the dotted lines at the sides, are designed to interlock with the ends of the crossdam referred to above. The dotted rectangles toward the bottom mark the entrances to the two conduits which will pierce the base of the crossdam. These conduits will be separated by a heavy concrete wall, the base of which appears in the boat-shaped structure between the rectangles. The conduits are 9 feet wide and 9 feet 2 inches high. It will be noted that they will be quite short, extending only from the rectangles as seen to the farther end of the boat-shaped structure, a distance of about 46 feet. This length should be contrasted with that of the Englewood conduits shown in figure 3 (about 700 ft.)